

BENCHMARKS

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NORTH TEXAS STATE UNIVERSITY

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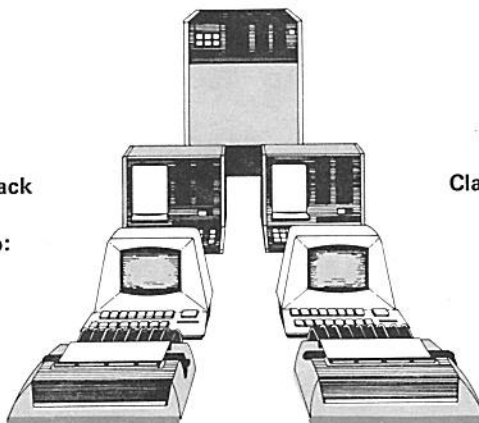
BENCHMARKS Reader/User feedback
is encouraged.

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Services Available To Users Of The NTSU Computing Facilities

All people mentioned below may be contacted by calling
(817) 788-2324:

Information and Project Numbers- Sandy Franklin or Sue Heffley
in the Computing Center Reception Area, ISB 119.

Test Scoring and Analysis - Sue Heffley or Sandy Franklin.

Newsletter Questions/Contributions/etc. - Claudia Putnam.

Statistical/Research Support (provided for graduate students
and faculty members) - Bob Brookshire, George Morrow,
Claudia Putnam, and Mohamad Salahshour.

Non-Research Student Programming Problems - student consultants
from the Computer Science Department, found in ISB 134A
near dispatch and the user keypunch area. Student
consulting provided by the College of Business is
available at the BA Computing Access Facility.

JCL and Debugging Problems - Mohamad Salahshour.

Pre-Research Counseling, Including Survey Instrument Design -
Bob Brookshire, George Morrow, and Claudia Putnam.

Data Entry to MUSIC, Keypunch Requests and Questions Regarding
Layout of Keypunch Sheets; Interpreting - Betty Grise,
ISB 227.

Academic Timesharing Information and/or Problems HP/2000 and
AS/5000 MUSIC (McGill University System for Interactive
Computing) information and problems, including terminal
problems - Mohamad Salahshour.

Administrative Applications - Coy Hoggard.

AS/5000 Computer Hardware/Software/Billing Problems - Sandy
Franklin.

JOB Submission and Retrieval - RJE Operators.

Summer Computing Hours

Computing facilities will be open during the following times
throughout the Summer Sessions (not applicable to holidays):

Computing Center RJE: 7 AM Monday to Midnight Saturday;
Noon to Midnight Sunday.

College of Business RJE: 8 AM - Midnight, Monday - Saturday;
Noon to Midnight Sunday.

Media Library (GAB): 8 AM to 10 PM Monday through Thursday;
8 AM to 6 PM Friday; 10 AM to 6 PM
Saturday; 2 PM to 10 PM Sunday.

MUSIC AND THE HP TO GET NEW TELEPHONE NUMBERS

Tuesday, July 27, the HP-2000 and MUSIC will be inaccessible from 9 to 9:15 AM. During that time, the telephone lines will be converted to the new telephone system being acquired throughout the campus. When the conversion is completed, at 9:15 AM, the following numbers will be in effect:

HP-2000 565-3300

MUSIC 565-3499

INTERPRETING SERVICE NO LONGER AVAILABLE THROUGH OPERATIONS

The IBM 029-C22 interpreting card punch that is located in the dispatch area of the Computing Center (ISB 134A) has cashed in its chips. Sadly, the 029, as it was called by its friends, has finally succumbed to age, hard work, and object decks. This means that the interpreting service that has long been a part of Operations will be no more. Fear not, however, for Data Entry is with you. For the trouble of walking up the stairs to ISB 227 (and the interpreting charge of \$5.00 per 1000 cards) you may have your cards interpreted by the much younger and flashier interpreting/keypunches housed there.

COMPUTING CENTER SUMMER II WORKSHOPS AND SHORT COURSES

If you intend to use the Computing facilities for Research/Instructional or word processing projects, the Computing Center is offering the following short courses for your benefit.

The course schedule is as follows:

Introduction to BMDP Monday/Wednesday July 26/28, 1982, from 1-3 p.m. General purpose statistical package especially good for Analysis of Variance designs.
INSTRUCTOR: Bob Brookshire.

Introduction to MUSIC Monday July 26, 1982, from 3-5 p.m. Good for those who wish to learn the interactive computing system here at NTSU. INSTRUCTOR: Claudia Putnam.

Introduction to SAS Tuesday/Thursday July 27/29, 1982, from 1-3 p.m. General purpose statistical package with many other capabilities. INSTRUCTOR: Claudia Putnam

Introduction to SPSS Tuesday/Thursday July 27/29, 1982, from 3-5 p.m. A general purpose statistical package especially good for social science data. INSTRUCTOR: Bob Brookshire.

Advanced Topics in MUSIC Wednesday July 28, 1982 from 3-5 p.m. Advanced usage of MUSIC NOT including MUSIC/SCRIPT. INSTRUCTOR: Mohammad Salahshoor

Introduction to MUSIC/SCRIPT Friday July 30, 1982, from 10 AM - 12 noon. Good for those who wish to utilize the computer do to word processing. INSTRUCTOR: Claudia Putnam

Introduction to HP/2000 Friday July 30, 1982, from 1-3 p.m. Provides a general introduction to the facilities available on the HP/2000 minicomputer. INSTRUCTOR: Jeff Brooks

REPORT ON COMPUTING FACILITIES PLANNING

As may be witnessed by the casual observer passing the general academic building, construction is now underway on the fifth floor of that structure. The space, when completed, will be occupied by the machine rooms of the Computing Center and by the Computer Science Department.

The finishing of the fifth floor of the GAB is part of a general effort on the part of the University to upgrade the level of computing at North Texas State University. In addition to new facilities for equipment, the Computing Center, along with the Computing Council, is currently managing a major procurement of new computing equipment which will include a new, larger, and more state-of-the-art IBM (compatible) machine(s), three Digital Equipment Corporation (DEC) VAX 11/780s, and a local area network (see related article in this issue) which will provide the means for using the new equipment.

The purchase order for the three DEC VAX 11/780s was completed last month. Two of the machines will be used for general purpose timesharing and will be managed directly by the Computing Center. The third VAX will be reserved for specialized experimentation and research, especially in Computer Science and other areas requiring more direct access to the machinery and operating system. The experimental/research machine will be managed by the Computer Science Department on behalf of the University.

The final decisions concerning the configuration of the IBM (compatible) machine have not yet been fixed.

Current estimates and contracts call for the completion of the construction of the fifth floor on or before February 15, 1983 and that date is the official date for installation of all equipment. It appears at this writing that the process is on time, which means that by early in the spring semester we will all be computing on newer, better, equipment.

TALKING TO THE COMPUTING FACILITIES

The Local Area Network

Part of the new look in computing at NTSU will be the construction of a Local Area Network (LAN) which will provide considerably better, and more reliable communications between our computing facilities and end users. The specific network system being established at NTSU is called a broadband system and is based on cable television (CATV) technology.

The reason for networking at all is to provide a means for connecting all computing equipment on the campus to all users on the campus with high speed, reliable, communications. While there are various networking approaches available, a Local Area Network will provide a considerable amount of connectivity which means, simply, that any two (or perhaps more) points or nodes on the network may talk to each other by the decision of the user. The network will be completely distributed in that a communication need not travel through any one computer or processor.

Because the network will be based on CATV technology the users of computing will share the medium with educational television. The ability to share the CATV facility is an important economy, of course. That sharing will also allow interested parties to combine television and computer technologies for more advanced systems of computer assisted instruction.

As far as the CATV part of the project is concerned, there will be cooperation between NTSU and Golden Triangle Communications (which provides cable television to Denton). Golden Triangle is committed by its franchise with the City of Denton to provide television services to the Campus and by working together we plan to provide many more services to the campus than would be possible by operating independently of one another. At some point in the future it should be possible for students, faculty, and staff to buy an add-on service to their basic cable service (at home) which will provide high-speed access to the computing facilities at NTSU.

In order to attach equipment to the Local Area Network it will be necessary for departments to acquire a radio frequency modem through the Computing Center. The initial cost of such a modem may be an important factor in various departmental budgets and planning should begin now for appropriate acquisitions. The Computing Center, the University Computing

Council, and the Computer Steering Committee will attempt to make the transition reasonably painless. If you need further information, please contact Tom Madron in the Computing Center (788-2324).

The long-term benefits of the connectivity provided by the Local Area Network will be seen not only in traditional areas of computer use but also in such emerging areas as office automation. It is the ultimate objective in the design of the network to provide a facility to which all computing equipment can be connected and through which it can be accessed. The use of the CATV technology will provide NTSU with a true state-of-the-art computer communications system.

USING THE COMPUTER FOR RESEARCH: PART IV By Bob Brookshire

This article is the fourth in a series of articles on computing and data analysis. The previous articles appeared in BENCHMARKS Volume 3, Numbers 2, 3, and 4.

What is a Computer?

From the point of view of the statistical package user, a computer consists of several components. The most important of these is the central processing unit (CPU), which processes your instructions and performs the mathematical operations. Attached to the CPU are peripheral devices, which include printers that print the results of your programs, tape and disk drives which advance the tapes and disks on which your data is stored so that it can be read by the CPU, card readers which transfer information from punched cards to the CPU, and terminals which can transmit information to or receive information from the central processing unit. These peripheral devices need not be located in close physical proximity to the CPU, in which case they are known as remote devices. A keypunch machine is not a peripheral device, since it is not connected to the CPU. It is merely a machine for punching holes in computer cards. Microcomputers such as the Apple or TRS80 are also not generally peripheral devices, but are instead small independent computers not linked with the NAS 5000 central processor. Some micros have the capability to be used as terminals, however, with the addition of special communications devices and the appropriate programs. In general, the devices and central processing unit are known as hardware. The sets of instructions for the computer to perform, the programs, are called software. You can distinguish between hardware and software by the following rule: If it's a machine, it's hardware; if it's a program, it's software. Computers are hardware, statistical packages are software.

Operating Systems

The major functions of the computer are directed by operating systems. An operating system is simply a series of programs that supervises the

execution of other programs. At North Texas, several operating systems are available. The two major systems that are used for research programming are MUSIC and OS/MVT.

MUSIC (Mcgill University System for Interactive Computing), is an operating system marketed by IBM. It is interactive in the sense that you can enter commands on a terminal, have the computer system respond immediately, enter another command, and so on. MUSIC has its own statistical package, STATPK, which will be described in detail in a later article in this series. Since it is an interactive package, you merely have to enter the data to be analyzed at the terminal, describe the data to STATPK, and request that a statistical procedure be performed. The results are printed at the terminal within seconds of your request, and you can then request another statistical analysis. This package is severely limited, however, in the number of procedures available and the amount of data that it can process.

Aside from STATPK, the MUSIC operating system is useful for data analysis in other ways. You can enter your data on the terminal in the MUSIC Context Editor, and it can be stored directly on magnetic disk. Your data can be displayed at the terminal, and any errors in data entry that have been made can be corrected. There are programs in MUSIC which can also copy these data files onto tape, print them on paper, or punch them on cards. You can also save your commands for the statistical package you are using (BMDP, SPSS, SAS, OSIRIS, etc.) on disk files in MUSIC, have them displayed at the terminal, edit them to correct mistakes, change the commands to request different or additional statistical analyses, and so on. In addition to its uses for statistical research, MUSIC also has the ability to do word processing, for reports, theses, dissertations, and books.

Most of the statistical packages at NTSU are supervised by the OS/MVT (Operating System/Multiprogramming with Varied number of Tasks) operating system. This system is also an IBM product, and was developed to be accessed primarily with punched cards. The structure of OS/MVT commands is radically different from that of MUSIC. OS/MVT is a batch operating system. This means that a dialogue, in the same sense as the interactive MUSIC operating system, cannot take place. Rather, you punch a series of commands on cards, have the cards read by a card reader into the computer system, the system processes the commands, and the results are then printed on paper by a line printer. You can use programs in OS/MVT to store your data on disk or tape, and these data files can be printed on paper or punched on cards. You cannot edit these data files, however. If there are errors in the data, the usual procedure is to replace the entire data file. You cannot store the commands for the statistical packages in OS/MVT. Instead, you keep your commands in a deck of punched cards, which can then be added to or replaced for new statistical analyses. Users cannot communicate directly with OS/MVT with a terminal. Some people find it convenient to use the OS/MVT system exclusively, communicating with the system through cards and storing their data on cards, disk or tape.

It is also possible, however, to use both MUSIC and OS/MVT for data processing, which allows you to overcome some of the disadvantages of these operating systems. The major advantages are that you can use the MUSIC Context Editor to enter, edit and store data and commands for the statistical packages, while at the same time accessing the more powerful procedures available in OS/MVT. This is accomplished through the use of the OSJE (OS Job Entry) and OSJR (OS Job Retrieval) programs in MUSIC, which will be described in more detail in the next issue of BENCHMARKS. In this way, you can communicate with OS/MVT on a terminal through the MUSIC operating system. Unless you are already comfortable using punched cards exclusively, it is recommended that you seriously consider this method for your research projects. Although it sounds complex, it is by far the most flexible, and is not difficult to learn. In fact, MUSIC contains programs which will provide you with instructions at the terminal on the use of almost all of its facilities.

Getting Access to the Computer

The first step in using the computer is obtaining a project number from the Computing Center. This project number is used to transfer the charges for computing services, including consulting, tape rental, and keypunching, as well as the actual use of the computer for data processing, from departmental or research grant budgets to the Computing Center. Only faculty are allowed to have project numbers, although faculty members may administer project numbers on behalf of their students. Students who wish to use the computer for research must therefore have a faculty sponsor. Forms for acquiring project numbers are available from the Computing Center secretaries. A project number is all that is necessary to use OS/MVT if punched cards are to be the medium of communication with the system.

If you wish to use a terminal, for the MUSIC system alone or for communicating with OS/MVT through MUSIC, you must also get a MUSIC user code. Charges for MUSIC usage are also referred to a project number; therefore, you must get a project number to get a MUSIC code. Applications for these codes can also be obtained at the Computing Center.

Terminals linked to the computer are available for general use in several locations around the campus. Terminals in the Media Library in the General Academic Building, and some of those in the Business Administration Building, are hardwired to MUSIC. That is, they are connected to the computer by permanent electrical cables. Other terminals in the Business Administration Building, and those in Wooten Hall, are connected temporarily to the computer through telephone lines through the use of a device called a modem. The telephone number for the MUSIC system is 566-1222. Card readers for the OS/MVT system are located in the Information Science and Business Administration Buildings.

The Computing Center regularly offers short courses in the use of the MUSIC system, and Computing Center personnel are available to give instruction in the use of the computer to academic classes at the request of instructors. Instruction in the use of MUSIC and OS/MVT is also offered by some instructors from other departments in their regular classes.

es. User's guides for the MUSIC system are available for purchase in the University Bookstore, and if you plan to use this system often, you should get this publication. Other user's guides to the various operating systems and facilities of the Computing Center will soon be available, and will contain information of interest to those who use statistical packages.

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* * * * *
*               *
*       S P S S   *
*               *
* * * * *
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Technical Notes on Repeated Measures Designs in SPSS MANOVA

The following article is reprinted from the magazine KEYWORDS: for users of SPSS Inc. software products, Number 28, March 1982, pages 9-14.

The implementation of MANOVA in Release 9 gives users a powerful and versatile analytic tool. In particular, MANOVA's ability to accommodate various types of repeated measures designs has struck a responsive chord in users' hearts. At SPSS Inc., we have noticed both in conversations with consultants and in calls to the SPSS technical line, that repeated measures designs in MANOVA constitute the largest area of comment and inquiry regarding use of MANOVA. This interest is probably due to a number of things: many researchers do repeated measures designs; there are various types of designs and approaches to analysis; MANOVA's syntax and documentation can be formidable; the organization of the data is an important consideration; and so on. This article introduces repeated measures designs, gives some examples and recommendations, and discusses some recurring problems encountered by MANOVA users.

A Simple Example

A repeated measures design is one in which multiple observations are made on a single experimental unit. The experimental unit is typically a human or animal subject. The measures might be educational scores, psychological scores, or drug levels in blood samples. The multiple measures are of the same type and have a time ordering to them. Since the observations are made on the same experimental unit, they are not independent. This explains the need for a distinct set of techniques for working with this type of data.

The simplest possible repeated measures design is a paired comparison. The two-sample paired comparison t-test is familiar. MANOVA can be used to do the same analysis as T-TEST for paired comparisons.

As an example, Figure 1 shows the prejudice scores of 20 boys both before and after seeing a particular educational film.

The test is designed so that the higher the score on this test, the more prejudiced the respondent. You might want to test whether the film affected the prejudice of the respondents in either direction.

Figure 1 Pre and Post Scores on Prejudice Test

CASE-N	PRE	POST
1	74	70
2	35	34
3	46	47
4	79	55
5	55	30
6	67	60
7	44	41
8	23	20
9	78	67
10	66	55
11	43	32
12	21	19
13	90	45
14	44	55
15	35	40
16	69	60
17	88	82
18	34	32
19	25	12
20	76	30

The SPSS job in Figure 2 shows how to use T-TEST and MANOVA to test for the difference in means.

Figure 2 SPSS Job Showing T-TEST and MANOVA

```

RUN NAME      USING MANOVA TO DO A PAIRED COMPARISON T-TEST
COMMENT       THE DATA ARE FROM WEINBERG AND SCHUMAKER "STATISTICS:
              AN INTUITIVE APPROACH", PAGE 212. DATA ARE A SET OF
              SCORES ON PREJUDICE TESTS BEFORE AND AFTER SEEING A FILM.
              N=20.
DATA LIST     FIXED (1)/1 PRE 1-2 POST 4-5
INPUT MEDIUM DISK
T-TEST        PAIRS=PRE WITH POST
MANOVA        PRE POST/
              WSFACTOR=WHEN (2) /
              WSDSIGN=WHEN/
              ANALYSIS (REPEATED) /
              RENAME=OVERALL PREVPOST

```

The results from the T-TEST are shown in Figure 3.

Figure 3 T-TEST Results for Paired Comparison

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR
PRE	20	54.6000	22.322	4.991
POST		44.3000	18.584	4.156

(DIFFERENCE) MEAN	STANDARD DEVIATION	STANDARD ERROR	* * CORR.	2-TAIL PROB.	* * T VALUES	DEGREES OF FREEDOM	2-TAIL PROB.
10.3000	14.704	3.288	* 0.756 *	0.000	* 3.13 *	19	0.005

In particular, the difference in the means is 10.3, the t-value is 3.13, and the two-tailed significance level is 0.005.

Consider the specification of the MANOVA command. The two dependent variables are PRE and POST. These variables are treated as jointly dependent variables. Note that no factors or covariates are specified. The WSFACTORS subcommand defines a **stand-in variable** named WHEN. That is, WHEN exists only within this invocation of the MANOVA procedure. The WSFACTORS subcommand establishes a one-two ordering of PRE and POST. The WSDSIGN subcommand establishes WHEN as an effect. The ANALYSIS subcommand invokes repeated measures analysis for this set of data. Just as in T-TEST, we are interested in the difference between PRE and POST scores, that is, the PRE-POST contrast. The RENAME subcommand makes explicit the fact that MANOVA is testing two effects: an overall effect, really not of interest, and the PRE-POST contrast, which is very much of interest.

A portion of the MANOVA output is shown in Figure 4.

Figure 4 The Pre-Post Contrast in MANOVA

***** ANALYSIS OF VARIANCE *****

20 CASES ACCEPTED.
 0 CASES REJECTED BECAUSE OF OUT-OF-RANGE FACTOR VALUES.
 0 CASES REJECTED BECAUSE OF MISSING DATA.
 1 NON-EMPTY CELLS.

 CORRESPONDENCE BETWEEN EFFECTS AND COLUMNS OF WITHIN-SUBJECTS DESIGN

STARTING COLUMN	ENDING COLUMN	EFFECT NAME
1	1	CONSTANT
2	2	WHEN

 SPSS BATCH SYSTEM

05/12/82

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***** ANALYSIS OF VARIANCE *****

ORTHONORMALIZED TRANSFORMATION MATRIX (TRANPOSED)

	1	2
1	.70711	.70711
2	.70711	-.70711

VARIATES	COVARIATES	NOT USED
1. Age	1. Age	
2. Sex	2. Sex	
3. Education	3. Education	
4. Income	4. Income	
5. Occupation	5. Occupation	
6. Religion	6. Religion	
7. Marital status	7. Marital status	
8. Health	8. Health	
9. Family size	9. Family size	
10. Social class	10. Social class	
11. Ethnicity	11. Ethnicity	
12. Political affiliation	12. Political affiliation	
13. Attitudes	13. Attitudes	
14. Values	14. Values	
15. Personality	15. Personality	
16. Intelligence	16. Intelligence	
17. Creativity	17. Creativity	
18. Motivation	18. Motivation	
19. Self-esteem	19. Self-esteem	
20. Resilience	20. Resilience	
21. Optimism	21. Optimism	
22. Pessimism	22. Pessimism	
23. Neuroticism	23. Neuroticism	
24. Conscientiousness	24. Conscientiousness	
25. Openness	25. Openness	
26. Agreeableness	26. Agreeableness	
27. Extraversion	27. Extraversion	
28. Introversion	28. Introversion	
29. Sensitivity	29. Sensitivity	
30. Empathy	30. Empathy	
31. Compassion	31. Compassion	
32. Altruism	32. Altruism	
33. Generosity	33. Generosity	
34. Kindness	34. Kindness	
35. Warmth	35. Warmth	
36. Affection	36. Affection	
37. Love	37. Love	
38. Friendship	38. Friendship	
39. Social skills	39. Social skills	
40. Communication	40. Communication	
41. Leadership	41. Leadership	
42. Teamwork	42. Teamwork	
43. Cooperation	43. Cooperation	
44. Conflict resolution	44. Conflict resolution	
45. Problem solving	45. Problem solving	
46. Decision making	46. Decision making	
47. Risk taking	47. Risk taking	
48. Innovation	48. Innovation	
49. Creativity	49. Creativity	
50. Imagination	50. Imagination	
51. Curiosity	51. Curiosity	
52. Exploration	52. Exploration	
53. Adventure	53. Adventure	
54. Novelty	54. Novelty	
55. Change	55. Change	
56. Growth	56. Growth	
57. Development	57. Development	
58. Progress	58. Progress	
59. Success	59. Success	
60. Achievement	60. Achievement	
61. Fulfillment	61. Fulfillment	
62. Satisfaction	62. Satisfaction	
63. Happiness	63. Happiness	
64. Well-being	64. Well-being	
65. Quality of life	65. Quality of life	
66. Life expectancy	66. Life expectancy	
67. Healthspan	67. Healthspan	
68. Longevity	68. Longevity	
69. Aging	69. Aging	
70. Geriatrics	70. Geriatrics	
71. Elder care	71. Elder care	
72. Senior services	72. Senior services	
73. Retirement	73. Retirement	
74. Pension	74. Pension	
75. Social Security	75. Social Security	
76. Medicare	76. Medicare	
77. Medicaid	77. Medicaid	
78. Long-term care	78. Long-term care	
79. Assisted living	79. Assisted living	
80. Nursing home	80. Nursing home	
81. Hospice	81. Hospice	
82. Palliative care	82. Palliative care	
83. End-of-life	83. End-of-life	
84. Bereavement	84. Bereavement	
85. Grief	85. Grief	
86. Mourning	86. Mourning	
87. Loss	87. Loss	
88. Death	88. Death	
89. Funerals	89. Funerals	
90. Burial	90. Burial	
91. Cremation	91. Cremation	
92. Organ donation	92. Organ donation	
93. Will	93. Will	
94. Estate planning	94. Estate planning	
95. Probate	95. Probate	
96. Trust	96. Trust	
97. Insurance	97. Insurance	
98. Financial planning	98. Financial planning	
99. Tax	99. Tax	
100. Legal	100. Legal	

← PREV POST

1 VARIABLE NOT USED

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* * * * * A N A L Y S I S C F V A R I A N C E * * * * *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIG. OF F
WITHIN CELLS	2054.10000	19	108.11053		
WHEN	1060.90000	1	1060.90000	9.81311	.005

WHEN

PARAMETER	COEFF.	STD. ERR.	T-VALUE	SIG.OF T	LOWER .95	UPPER .95
1	7.2831998462	2.32498	3.13259	.005	2.41696	12.14944

The analysis of variance table shows that the WHEN effect is statistically significant. That is, PRE and POST scores differ significantly. The ESTIMATES FOR PRE-POST statistics contain some familiar numbers. The T-VALUE is 3.13259 and the SIGNIFICANCE of T is 0.005, just as in T-TEST. Where does the number 7.2831998462 come from? If you multiply this number by the square root of 2, which is 1.4142136, you get 10.3, which is the difference in means of PRE and POST scores. The "magic" number square root of two comes from the fact that MANOVA builds orthonormalized contrast vectors for the overall effect and the PRE versus POST effect.

Figure 4 displays the contrast vectors as columns. Column 1 adds PRE and POST and weights them equally. Column 2 contrasts PRE and POST; that is the effect of the minus sign. Where does the number 0.70711 come from? 0.70711 is one divided by the square root of two. The two columns are normalized because the sums of squares of their elements are 1. Note,

COLUMN 1: $0.70711^2 + 0.70711^2 = 1$
 COLUMN 2: $0.70711^2 + (-0.70711)^2 = 1$

The two columns are also orthogonal; if you multiply the side-by-side elements together and sum the products, you will obtain zero as the result.

$0.70711 * 0.70711 + 0.70711 * (-0.70711) = 0$

To summarize, you can use MANOVA to perform a paired comparison t-test, which is the simplest possible repeated measures design. RENAME is an optional subcommand which you should employ to make clear what effect is being tested. In conjunction with this, you can read the orthonormalized transformation matrix which MANOVA prints to see what contrasts and combinations MANOVA builds. Finally, the actual values of the parameter estimates that MANOVA prints are of less interest than are the associated t-values and levels of significance.

Two Set-ups: A Comparison

There are two fundamental set-ups for analyzing repeated measures data: the univariate set-up and the multivariate set-up. Each has things to recommend it. Before looking at the good and bad points of each, let's consider how they arise.

In the multivariate set-up, your data are organized so that each case consists of information on one subject. For example,

SUBJECT	PRE	DURING	POST
1	50	54	63
2	43	46	48
3	56	61	64
.	.	.	.

has three scores for each subject. In contrast, the univariate set-up has data organized as follows:

SUBJECT	TIME	TESTSCOR
1	1	50
1	2	54
1	3	63
2	1	43
2	2	46
2	3	48
3	1	56
3	2	61
3	3	64

The scores are strung out across cases, which is inefficient for a variety of reasons.

Historically, MANOVA existed first in the CDC version of SPSS. In this version, the univariate set-up was the only one possible. However, the redesigned MANOVA explicitly took the multivariate set-up into account. In addition to forcing you to spread your data, there are three drawbacks to the univariate set-up. First, the univariate set-up implies that you are using a mixed model analysis of variance approach to your data. That is, subject is treated as a random effect nested under the between-subjects factor. In this approach, certain symmetry assumptions must be met. Second, specification of the DESIGN statement can be very complicated. Third, the univariate set-up is computationally inefficient. The univariate set-up does have some recommend uses. First, when appropriate, this approach has greater power. Second, when there are many missing subject scores, this approach makes fuller use of the data.

The multivariate set-up is generally preferable for the following reasons. First, as already seen, data organization is much easier. Second, MANOVA syntax, including the DESIGN statement, is much easier to prepare. Third, no assumption of symmetry is necessary. Fourth, the univariate analysis results are completely recoverable. The drawbacks to the multivariate set-up are those situations in which the univariate set-up is preferable: that is, the multivariate set-up is less powerful when you have a small number of cases, and, in addition, it should not be used when there are too many missing subject responses, because deletion of cases with missing values on some of the scores can dramatically lower your valid case-base.

An Example of the Multivariate Set-up

We now show a prototypical set of MANOVA commands in the context of a more realistic example than the previous one. In this example, there is one grouping factor which splits the subjects into two groups. GROUP is a between-subject factor. There are six measurements on each subject, because each of two drugs was administered at each of three dosages to the subjects. DRUG and DOSE are each within-subject factors. The data are from a bioassay in which we wish to estimate the relative potency of two drugs which inhibit a response to a stimulus. See Figure 5.

Figure 5 Data in a Repeated Measures Design

GROUP	SUBJECT	DRUG	1			2		
		DOSE	1	2	3	1	2	3
1	1		19	22	28	16	26	22
	2		11	19	30	12	18	28
	3		20	24	24	24	22	29
	4		21	25	25	15	10	26
	5		18	24	29	19	26	28
	6		17	23	28	15	23	22
	7		20	23	23	26	21	28
	8		14	20	29	25	29	29
2	9		16	20	24	30	34	36
	10		26	26	26	24	30	32
	11		22	27	23	33	36	45
	12		16	18	29	27	26	34
	13		19	21	20	22	22	21
	14		20	25	29	29	29	33
	15		21	22	23	27	26	35
	16		17	20	22	23	26	28

Subjects in group 1 received the three doses of drug 1 first and the three doses of drug 2 second. Group 2 subjects received drug 2 first and drug 1 second. Note that the within-subjects factors are not SPSS variables; the ordering of the six responses plus appropriate specifications of MANOVA syntax establish DRUG and DOSE as factors for the duration of the procedure.

The SPSS commands shown in Figure 6 can be used to perform the analysis of variance of the above data.

Figure 6 The Multivariate Set-Up in SPSS MANOVA

```

RUN NAME      A REPEATED MEASURES DESIGN EXAMPLE
COMMENT       THE DATA COME FROM ELASHOFF, "DATA FOR
              REPEATED MEASURES ANOVA", UNPUBLISHED REPORT,
              CALIFORNIA CENTER FOR ULCER RESEARCH.
DATA LIST     FIXED/1 Y1 TO Y6 1-18 GROUP 19
N OF CASES    16
MANOVA        Y1 TO Y6 BY GROUP (1,2)/
              WSFACTOR=DRUG(2), DOSE(3)/
              WSDSIGN=DRUG,DOSE,DRUG BY DOSE/
              ANALYSIS(REPEATED)/
              RENAME=OVERALL DRUG1V2 DOSE1V3 DOSE2V13 INT1 INT2/
              PRINT=SIGNIF(BRIEF)/
              DESIGN=GROUP/

```

```

READ INPUT DATA
19 22 28 14 26 22 1
11 18 39 12 18 28 1
20 24 24 24 22 29 1
21 25 25 15 10 26 1
18 24 29 19 26 28 1
17 23 28 14 23 22 1
20 23 23 26 21 28 1
14 20 29 25 29 29 1
16 20 24 30 34 36 1
26 26 26 24 30 32 1
22 27 23 33 36 45 2
16 18 29 27 26 34 2
19 21 20 22 22 21 2
20 25 25 29 29 33 2
21 22 23 27 26 35 2
17 20 22 23 26 28 2
END INPUT DATA

```

Y1 to Y6 are the multiple dependent variables associated with different levels of the within-subjects factors. GROUP is the between-subjects factor with two levels.

Subcommand WSFACTORS defines the within-subjects factors, which are DRUG with 2 levels and DOSE with 3 levels. Any valid, unique SPSS name can be used to define the within-subjects factors. The order in which the factors are specified is crucial; they must be specified in the order corresponding to the dependent variable list. Note that the index value of the rightmost within-subjects factor increments most rapidly. MANOVA allows only one WSFACTORS subcommand in a given invocation; place this subcommand right after the MANOVA specification.

The WSFACTORS subcommand specifies the design model for the within-subjects factors. In Figure 6, a full model is specified.

The ANALYSIS subcommand invokes a repeated measures analysis. MANOVA builds an orthonormal transformation matrix and uses this matrix to transform the original response variables. After the transformation in our example, the new Y1 is used to test the GROUP effect, Y2 is used to test DRUG and GROUP by DRUG, Y3 and Y4 are used to test DOSE and GROUP BY DOSE, and Y5 and Y6 are used to test DRUG BY DOSE and GROUP BY DRUG BY DOSE. Thus, by specifying ANALYSIS(REPEATED), you instruct MANOVA to build the appropriate response variables for testing effects.

The RENAME subcommand, while not required, improves the readability of the output. Names chosen should reflect the transformation employed. To see what the transformation does, either consult SPSS Update 7-9 or find the orthonormalized transformation matrix in the output. Reading the latter admittedly takes practice. In the absence of anything else, rename the variables using generic names. For example,

```
RENAME=Z1 Z2 Z3 Z4 Z5 Z6/
```

will do. This good habit emphasizes that contrasts among the original variables are being estimated, and not the variables themselves. In the example, the names chosen reflect the effects being tested. OVERALL is the general mean effect. DRUG1V2 is the contrast between drug 1 and drug 2. DOSE1V3 is the contrast of dose 1 and dose 3. DOSE2V13 is the contrast between dose 2 and the combination of dose 1 and dose 3. INT1 and INT2 are interactions.

The PRINT subcommand specifies that a brief significance table be printed in addition to the default output. This brief significance table contains the average F statistic, which was previously alluded to in the comparison of the univariate and the multivariate approaches. The average F statistic is the F statistic that is produced if the univariate approach is used. However, when you use the multivariate approach, MANOVA also prints an approximate multivariate F derived from Wilks' lambda.

Finally, the DESIGN subcommand specifies the model for the between-subjects factors. In the example, GROUP is the only between-subjects factor.

Figure 7 displays the number of cases used in the analysis and the design model for the within-subjects factors.

Figure 7 N of Cases and Effects Correspondence Table

A REPEATED MEASURES DESIGN EXAMPLE

FILE NONAME (CREATION DATE = 05/12/82)

***** ANALYSIS OF VARIANCE*****

16 CASES ACCEPTED.
 0 CASES REJECTED BECAUSE OF OUT-OF-RANGE FACTOR VALUES.
 0 CASES REJECTED BECAUSE OF MISSING DATA.
 2 NON-EMPTY CELLS.

CORRESPONDENCE BETWEEN EFFECTS AND COLUMNS OF WITHIN-SUBJECTS DESIGN

STARTING COLUMN	ENDING COLUMN	EFFECT NAME
1	1	CONSTANT
2	2	DRUG
3	4	DOSE
5	6	DRUG BY DOSE

Figure 8 displays the orthonormalized transformation matrix and the design model for the grouping factor. This matrix is used to transform the original variables Y1 and Y6.

Figure 8 Transformation Matrix and Design Model

A REPEATED MEASURES DESIGN EXAMPLE

05/12/82 PAGE 3

* * * * * A N A L Y S I S O F V A R I A N C E * * * * *

ORTHONORMALIZED TRANSFORMATION MATRIX (TRANSPosed)

	1	2	3	4	5	6
1	.40825	.40825	.50000	-.28868	.50000	-.28868
2	.40825	.40825	0.0	.57735	0.0	.57735
3	.40825	.40825	-.50000	-.28868	-.50000	-.28868
4	.40825	-.40825	.50000	-.28868	-.50000	.28868
5	.40825	-.40825	0.0	.57735	0.0	-.57735
6	.40825	-.40825	-.50000	-.28868	.50000	.28868

CORRESPONDENCE BETWEEN EFFECTS AND COLUMNS OF BETWEEN-SUBJECTS DESIGN

STARTING COLUMN	ENDING COLUMN	EFFECT NAME
1	1	CONSTANT
2	2	GROUP

Figure 9 shows the main results of the analysis.

Figure 9 Tests of Significance

***** ANALYSIS OF VARIANCE*****

TESTS OF SIGNIFICANCE FOR OVERALL USING SEQUENTIAL SUMS OF SQUARES

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIG OF F
WITHIN CELLS	53297.91667	14	3806.99405		
CONSTANT	5563251.04167	1	5563251.04167	1461.32381	0.0
GROUP	27001.04167	1	27001.04167	7.09248	.019

WITHIN CELLS	37564.58333	14	2683.18452		
DRUG	34884.37500	1	34884.37500	13.00111	.003
GROUP AND DRUG	32534.37500	1	32634.37500	12.16255	.004

DOSE	.20466	25.26075	.000	35.50967	0.0
GROUP AND DOSE	.81738	1.45223	.270	2.03394	.150

***** ANALYSIS OF VARIANCE*****

TESTS OF SIGNIFICANCE FOR WITHIN CELLS USING SEQUENTIAL SUMS OF SQUARES

SOURCE OF VARIATION	WILKS LAMBDA	APPROX MULT F	SIG OF F	AVG F	SIG OF F
DRUG BY DOSE	.87396	.93739	.417	.68152	.514
GROUP AND DRUG BY DOSE	.85585	1.08583	.366	.83689	.444

First, the OVERALL effect is chosen as the response variable, and an ANOVA table for GROUP is given. The F value of GROUP is 7.09248 with an observed significance level of 0.019. Next, the test of DRUG and GROUP BY DRUG is based on the DRUG1V2 effect. Note that both of these sources of variation have significant F statistics. Third, the tests of DOSE and GROUP BY DOSE are based jointly on the DOSE1V3 and DOSE2V13 variates. The output shows two F values. The approximate multivariate F is obtained from a transformation of the Wilks' lambda and is the test statistic for the multivariate approach. The F value under the AVERAGE F heading is for the univariate approach. For example, the F values for

the DOSE effect in the multivariate and univariate approaches are 25.26075 and 36.5097 respectively. Both tests lead to the same conclusion regarding significance. Finally, results are presented for the two interaction effects.

To summarize, on the assumption that you will use the multivariate set-up whenever possible, here is a suggested order to the subcommands.

- The initial variable specification list, which follows the general form: joint dependent varlist BY between-subjects factors WITH covariates.
- WSFACORS
- CONTRAST - where applicable
- PARTITION - where applicable
- WSDSIGN
- ANALYSIS(REPEATED)
- RENAME
- PRINT - especially SIGNIF(BRIEF) to obtain the average F
- Other Subcommands - PLOT, METHOD - as desired
- DESIGN

Recurring MANOVA Problems

The following brief remarks discuss some topics that have occasioned calls to SPSS Inc.

Insufficient Memory

Unlike most other procedures in SPSS, MANOVA allocates memory dynamically. Occasionally, large processing tasks cause the program to blow due to insufficient memory. Ordinarily, you can examine the output where an insufficient memory error occurs to see how much WORKSPACE is required for the task. However, with respect to MANOVA, the WORKSPACE requirement message will most likely underestimate the amount of WORKSPACE needed for the entire set of tasks. One conservative rule of thumb is to multiply the printed value by 4 to obtain a working estimate.

OMEANS and PMEANS in MANOVA

Note that when you request OMEANS and PMEANS, these are printed for the transformed variates, if TRANSFORM or ANALYSIS(REPEATED) has been specified, and not for the original variables.

Covariates in the Multivariate Set-up

MANOVA accomodates covariates in repeated measures designs. You need as many covariates as dependent variables. If the covariate is constant across the repeated measures factors, you probably have fewer covariates than repeated measures variates. In this case, use COMPUTE to create as many replicates of the covariate as you need.

Doubly Multivariate Repeated Measures

Suppose that you administer two types of tests at different times. If you use the multivariate approach to analyze this design, the syntax is straightforward. In the example from above, let X and Y be the two types of tests. Then, the MANOVA syntax is

```
MANOVA      X1 TO X6 Y1 TO Y6 BY GROUP(1,2) /  
            WSFACTOR=DRUG(2) DOSE(3) /  
            WSDSIGN=DRUG,DOSE,DRUG BY DOSE /  
            ANALYSIS(REPEATED) /  
            DESIGN=GROUP /
```

```
* * * * *  
*           S   A   S           *  
* * * * *
```

SAS for the Visually Impaired

The SAS Introductory Guide is now available from Recording for the Blind, Inc. for people whose physical handicaps prevent them from reading normal printed material. Recorded texts are not for sale; there is no charge for use of the tapes. To order, write or call:

Recording for the Blind, Inc.
215 East 58 Street
New York, NY 10022
(212) 751-0860

The SAS User's Guide, 1979 Edition is also available.

Using Tapes With SAS

The RETAIN keyword should always be used in the DD statement requesting a tape mount, when using a tape with SAS in which files on the tape will be referred to in more than one SAS DATA step or PROC. RETAIN is part of the VOL parameter in the DD statement:

```
          //TAPE DD VOL=(,RETAIN,SER=nnnnnn),UNIT=TAPE9,UNIT=TAPEDD,
          // LABEL=(1,SL)
```

This will keep SAS from issuing repeated dismount and remount commands to the Operator's console. Omitting this keyword could cause your job to be cancelled due to repetitious mounting.

```
*****
*
*          M U S I C
*
*****
```

Library Maintenance on MUSIC

Efficient maintenance of your Save Library files is possible through the use of the CAT command. This command, an NTSU enhancement to MUSIC, was documented in the October 1981 issue of BENCHMARKS, Volume 2 Number 6.

Like the LIBRARY command, the CAT command is used primarily to obtain an alphabetic list of names of files saved in a user's SAVE Library. If you have a lot of files, it can become quite difficult to keep track of what their names are, what they contain, etc. One way to do this would be to use the Save parameter of the CAT or the LIB command to save a list of all the files contained in your SAVE Library (enter HELP CAT or HELP LIB while signed-on to MUSIC, or consult the MUSIC at NTSU Manual for more information on how to do this). The PTPCH utility could then be used to get a hardcopy list of the names of all your files (enter PTPCH HELP while signed-on to MUSIC, or consult the March 1981 issue of BENCHMARKS, Volume 2 Number 2, for more information on this utility). You could then set about listing and/or purging those files, working from the hardcopy list.

A more efficient way to do this, would be to use the Pack and Save parameters of the CAT command to save a list of file names to a file (normally called @LIB), and then Edit this saved file, entering the List or PURGE command and a file name while still in Edit mode. This way the list of file names will remain on your screen and you can still list or purge files, without exiting the edit session. If you have FULL SCREEN capabilities on your screen, you can delete the file names from your file as you purge them.

Routing Print/Punch from OS/MVT to MUSIC

It is now possible to route print/punch from MVT to MUSIC. This is accomplished by including the following card somewhere in your JOB, after your JOB Card:

```
/*ROUTE PRINT MUSIC  
<PUNCH>
```

Obviously, the PRINT/PUNCH parameters are interchangeable, depending on the nature of the task. It is also necessary for the first four characters of the JCBNAME to follow the MUSIC naming convention; i.e. it should be the same as the first four characters of the MUSIC ID-Code that the print/punch is being sent to.

How to Deal With Characters Not on Your Terminal

Occasionally you may find that your terminal keyboard does not include a certain special character, or it uses a different symbol to represent it. For example, the VERTICAL STROKE '|', employed frequently by PL/I programmers, is represented by the carat symbol '^' on the MIME terminal keyboard. The TRS80 terminal doesn't have a key for the NOT sign '~'.

To overcome the problem, a public file called **KEYBOARD3270** has been created, which includes the name, symbolic notation, and hexadecimal value for the most commonly used special characters. Simply key in **KEYBOARD3270** at your terminal and match the displayed symbol for the desired special character with those on your terminal keyboard. If a match is found, you have found the right symbol; otherwise, write down the hexadecimal value of the desired symbol as shown at your terminal and perform the following steps:

1. Use the MUSIC Context Editor to edit or create the text file in which you wish to include the desired special character.
2. Choose a character, or string of characters, to represent the special character that your keyboard does not contain.
3. Key in the substitute character for every occurrence of the special character in your text file.
4. Issue a Top command to set your current line at the top of the text line.
5. Issue a XIN command to indicate input entry in hexadecimal format.
6. Issue a global CHANGE command (see page 195 of the MUSIC at NTSU Manual) to replace the hexadecimal value of the special character for every occurrence of the substitute character in step 3.

7. Issue an AIN command to indicate restoration of normal alphanumeric input format.

To clarify the above procedure, assume that you are going to enter the following text lines at your terminal, and your keyboard doesn't include a key for the NOT symbol. Also assume that you have chosen to substitute a QUESTION MARK " ? " for every occurrence of the NOT symbol. Enter the following lines using CONTEXT EDITOR:

```
I AM GOING TO KEY IN AN QUESTION MARK FOR
EVERY OCCURRENCE OF THE NOT SYMBOL " ? "
IN THIS TEXT.
A GLOBAL CHANGE COMMAND WILL THEN REPLACE
EACH QUESTION MARK WITH A " ? ", WHICH IS
THE NOTATION FOR THE NOT SYMBOL.
```

Now enter a blank line to terminate input mode. Then enter the following commands:

```
TOP;XIN
CHANGE /?/5F/*
```

Note that there MUST BE an intervening blank between the CHANGE command and the delimiter '/'.

Now your text file should look like the following:

```
I AM GOING TO KEY IN AN QUESTION MARK FOR
EVERY OCCURRENCE OF THE NOT SYMBOL " ~ "
IN THIS TEXT.
A GLOBAL CHANGE COMMAND WILL THEN REPLACE
EACH QUESTION MARK WITH A " ~ ", WHICH IS
THE NOTATION FOR THE NOT SYMBOL.
```

Now issue an AIN command to enter input in alphanumeric format. For more information see the MUSIC AT NTSU Manual, pp. 174-75.

```
* * * * *
*           *
*   H P - 2 0 0 0   *
*           *
* * * * *
```

Demonstration ID Available on the HP

A general ID-code is available on the HP-2000 for demonstration purposes. This ID-code may be accessed by entering:

HELLO-A098,PGREEN

Press the key labelled RETURN. <The password, PGREEN, is typed wit. at holding the Control (CTRL) Key down.>

A900 Pseudo-System Library

The HP-2000 account number A900 contains a number of user contributed files which are dealt with in a manner very similar to those in the System Library. The A900 programs are designed to be accessible to all HP-2000 users for execution. Most of these files are programs, some of which are referred to as 'macros' -- programs which perform a particular function when referenced by another program using the name of the macro as a program command. The rest are either appendices or documents pertaining to A900 programs or data files utilized by them.

Detailed documentation concerning most of the programs can be obtained by

EXEcuting DOCPRT-A900

The A900 programs can be executed by typing

EXE-programname.A900

The following list contains the names of the A900 programs including the macros (PRO=program, MAC=macro) and a brief description of each:

NAME	TYPE	DESCRIPTION
-----	----	-----
ALANG	PRO	Assembly Language Simulator.
ALISTR	PRO	Lists contents of an ASCII file.
ARRAY-SIZE	MAC	Finds size of 1 or 2 dimensional array.
ASSIGN	MAC	Assigns a file.
CALNDR-JULIAN	MAC	Converts calendar date to Julian.
CAT	PRO	Lists catalog in either single or three column format and produces a catalog summary as well.
CHECK-DATE	MAC	Checks for validity of date.
DATE	MAC	Returns Day-Date-Time-Port Number.
DEL-BLANKS	MAC	Deletes blanks from a string.

DOCPRT	PRO	Prints available documentation for some A900 files.
ERROR	MAC	Handles execution errors.
EXTEND	MAC	Extended precision arithmetic.
FILCPY	PRO	Copies ASCII OR BASIC-formatted files.
FILE-ASSIGN	MAC	Assigns a file.
FILE-NAME	MAC	Qualifies a file name.
FILE-SIZE	MAC	Determines size of a BASIC file.
FILE-TYPE	MAC	Finds file type (ASCII or BASIC).
FILRPT	PRO	Prints a summary of a BASIC-formatted file.
FINDIT	PRO	NTSU-modified version of \$FINDIT.
INC-DATE	MAC	Increment a date by days.
INIT-DATE	MAC	Initializes date.
JULIAN-CALNDR	MAC	Julian date to calendar conversion.
KEYWORD	MAC	Finds keywords in a string.
LISTER	PRO	Lists contents of a BASIC-formatted file.
MACROS	MAC	Macro processor for EASIC.
MOUSE	PRO	Mouse-in-maze demo for ADM3A CRT.
MLANG	PRO	Machine Language simulator.
NTXREF	PRO	Prints cross reference of a BASIC program.
PLTPKG	PRO	Plot package for TEKTRONIX terminals.
POLCAT	PRO	Calculator program.
SORT01	PRO	Sorts a sequential ASCII or BASIC file.
SSRCH	PRO	Searches a file for specified strings.

SSRCH1	PRO	Modification of SSRCH.
STRING-SIZE	MAC	Finds the length of a given string.
SYSPDS	PRO	File Processor/Text Editor.
SYSTEM	MAC	Processes System commands.
TINPUT	MAC	Terminal input routine.
YES-NO	MAC	Processes Yes/No responses.

In order to have a program placed in the A900 Library, the following requirements must be met:

1. The program must be fully demonstrated in order to show that the program is viable and that it performs properly.
2. The program must be accompanied by separate documentation that completely explains what the program does and how to use it.
3. The beginning of the program must contain the following information in the form of REMark statements:

```

Program name and purpose
Contributor's name
Contributor's address and phone number
Date program was written (and/or last update)
Date of contribution
Any operational notes required
Bibliographic citation if the program has
                                been published

```

This heading informs the user of the person who is responsible for the maintenance of the program and for answering questions concerning the program. The Computing Center will accept no responsibility other than to screen the programs and to make the written documentation available. The contributor is responsible in all other cases including notifying the Computing Center if he/she is leaving the university and of the person who will assume his/her responsibilities. Programs whose contributor disappears for an extended period of time while neglecting to reallocate his/her responsibilities will be in danger of being removed from the A900 library.

HP Notes

1. Be sure to note the information concerning the new telephone numbers for dial-up access to the HP on page 2 of this issue of BENCHMARKS. Keep up with the System News (EXEcute-\$NEWS) and/or the log-on messages for further developments.
2. **REMEMBER** all faculty and student ID-codes will expire on September 1, 1982, so make certain that you RENEW your ID-code during the month of August or you might regret having not done so. Also, ID-codes assigned through first Summer session classes will expire on July 7, 1982. Therefore, if you have files that you would like to keep, transfer them to your student ID-code, if you have one, or, if you don't have one, apply for one at the Computing Center (ISB- 119) and then transfer your class files to your new ID-code before July 7.
3. If you are ever curious about the present status of your HP account, you can check on it by doing the following;
 - a) EXEcute-EXPIRE.A900
This program will tell you when the ID-code to which you are logged on is scheduled to expire. If you feel that there is a discrepancy between your records and those of the Computing Center contact the HP Coordinator (788-2324).
 - b) Enter 'LEN'
LENGth is a System command which tells you how much disk space your account has used of that which has been allocated to it.
 - c) Enter 'TIM' TIME is a System command which informs you of the amount of terminal time your account has used of that which has been allocated to it.

```
* * * * *  
*          *  
*  COMPUTER HUMOR  *  
*          *  
* * * * *
```

Extensions to Babbage

An article appeared in DATAMATION in 1981 entitled "Babbage: Language of the Future." This article proposed a programming language to replace all other programming languages - Babbage. This language, named after Charles Babbage, "the first systems designer to go over budget and behind

schedule, was to be funded by the United States Department of Sanitation. It would run on a "state-of-the-art" operating system called VTOS (Virtual Time Operating System), which makes CPU processing time a virtual resource. This results in an unlimited number of jobs being run at the same time. Like VM, VTOS has to play tricks to achieve its goals, so while some jobs appear to be running in the present, they are actually running next week.

Some of the features of Babbage proposed by Tony Karp, the author of the DATAMATION article were:

- A method for passing parameters to subfunctions termed "call by telephone." This method is especially effective for long-distance parameter passing.
- A number of conditional statements that act like termites in the structure of your program:
 - WHAT IF - Used in simulation languages. Branches before evaluating test conditions.
 - OR ELSE - Conditional threat, ex.: "Add these two numbers OR ELSE!"
 - WHY NOT - Executes the code that follows in a devil-may-care fashion.
 - WHO ELSE - Used for polling during I/O operations.
 - ELSEWHERE - Where your program really is when you think it's here.
 - GOING GOING GONE - For writing unstructured programs. Takes a random branch to another part of your program. Does the work of 10 GOTO's.
- A number of loop statements:
 - DON'T DO WHILE NOT - Not executed if the test condition is not false (or if it's Friday afternoon).
 - DIDN'T DO - The loop executes once and hides all traces.
 - CAN'T DO - The loop is pooped.
 - WON'T DO - The CPU halts because it doesn't like the code inside the loop. Execution can be resumed by typing "May I" at the console.
 - MIGHT DO - Depends on how the CPU is feeling. Executed if the CPU is "up", not executed if the CPU is "down" or if its feelings have been hurt.

- **DO UNTO OTHERS** - Used to write the main loop for timesharing systems so that they will antagonize the users in a uniform manner.
- **DO-WAH** - Used to write timing loops for computer-generated music (Rag Timing).
- **A variety of case statements:**
 - The **JUST-IN-CASE** Statement - For handling afterthoughts and fudge factors. Allows you to multiply by zero to correct for accidentally dividing by zero.
 - The **BRIEF CASE** Statement - To encourage portable software.
 - The **OPEN-AND-SHUT CASE** Statement - No proof of correctness is necessary with this one.
 - The **IN-ANY-CASE** Statement - Always works.
 - The **HOPELESS CASE** Statement - Never works.
 - The **BASKET CASE** Statement - A really hopeless case.
- The **ALMOST EQUALS SIGN** - used for comparing two floating point numbers. It "takes the worry out of being close".

The following contribution, by Tim Puckett of the Systems Group here at the Computing Center, is a reaction to the DATAMATION article.

I felt that BABBAGE needed some debugging aids to help the user debug his/her program. One good debugging aid is **DWIM** (DWIM stands for Do What I Mean). When Babbage interprets this command it will interpret any instructions after this command and execute them the way the programmer meant for them to be executed, not the way he/she wrote them. Another good debugging aid is **WIZARD**. This command is a self-debugging tool; each time the program is run, one or more bugs in the program disappears until the program is completely bug free (the number of bugs that disappears is dependent on how close the program is to deadline). The third debugging aid is called **WINDOW**. The window command allows the programmer to see what Babbage is doing to his/her program and also allows Babbage to see the expressions of the helpless programmer. The fourth and last debugging aid is called **MIRROR**. This debugging aid fools the programmer into thinking that his/her programs are running the way they thought the programs should, not the way the compiler executes them.

Along with the enhanced debugging aids, another extension to Babbage is the **MAYBE SIGN**. The maybe sign is used in decision making when the case is neither yes nor no.

A need exists for a few more extensions to Babbage in order to make it the language of the future, but I think we have a pretty good start. In case any of you can think of any other enhancements to Babbage please send a memo to Claudia Putnam (FA14) while signed-on to MUSIC, or through inter-campus mail.

INDEX TO PAST ISSUES

In order to utilize BENCHMARKS to its fullest capacity and avoid redundancies, an index of previous issues containing information considered still pertinent to the NTSU Computing Center is included in each issue.

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REGISTRATION FORM FOR COMPUTING CENTER SHORT COURSES

Please complete this form and return it AS SOON AS POSSIBLE if you wish to attend any of the short courses announced in this issue.

NAME: _____ DEPARTMENT: _____

PHONE: _____

I wish to attend :

Introduction to MUSIC __ July 26, 3-5 PM

Introduction to MUSIC/SCRIPT

__ July 30, 10 AM - 12 NOON

Introduction to SPSS __ July 27/29 3-5 PM

Introduction to SAS __ July 27/29 1-3 PM

Advanced MUSIC __ July 28, 3-5 PM

Introduction to BMDP. __ July 26/28 1-3 PM

Introduction to HP/2000

__ July 30, 1-3 PM

PLEASE RETURN TO:

Academic Computing Services
The Computing Center
NT Box 13495
North Texas State University
Denton, TX 76203

GET A "SUBSCRIPTION" TO BENCHMARKS

BENCHMARKS is a vital link between the NTSU Computing Center and the users of our facilities. It is important for all users of the computing facilities to maintain a file of these newsletters because they contain materials which will periodically update existing documents as well as information and suggestions on uses of OS-MVT, MUSIC, the HP-2000, and other resources available to NTSU students and faculty. To facilitate the dispersal of BENCHMARKS, *** FREE *** subscriptions are now available. To receive yours, send the following information to us either by "snail mail" (the post office or campus mail) or electronically, through the MAIL facility on MUSIC.

Name _____

Mailing Address _____

PLEASE GIVE A CAMPUS ADDRESS (NOT BOX) IF POSSIBLE - It's Cheaper !

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